

SHRI GURU RAM RAI UNIVERSITY

[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]



Curriculum & Syllabus

for

M.Sc. (Ag.) Entomology

Department of Entomology
School of Agricultural Sciences

Pathri bagh, Dehradun-248001, Uttarakhand

SHRI GURU RAM RAI UNIVERSITY

Pathribagh, Dehradun-248001, Uttarakhand

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M.Sc. (Ag.) Entomology

Programme Outcomes (POs):

PO-1	Quality education in Agriculture with special reference to Agronomy, Soil Science, Horticulture, Entomology, Plant Pathology, Seed Science & Technology and crop improvement to the solution of Agriculture related issues.
PO-2	Understand and analyze the current events and issues that are occurring in agriculture and how they affect futuristic agriculture.
PO-3	Skills to select and apply natural resources, modern techniques and IT tools for weather forecasting, soil analysis, Pest management and quality seed production of food crops.
PO-4	Research oriented innovative ideas should be recognized and examine the relationship between inputs and outputs in the Agricultural field to make profitable decisions.
PO-5	Research based knowledge of the environment and recognizes the importance of crop biodiversity in the field to preserve Agro-ecosystem
PO-6	Able to recognize and examine the relationship between employer and students which enhance career opportunities in different sectors
PO-7	Demonstrate the impact of globalization and diversification of Agriculture Extension Programmes to disseminate modern technologies for farmer's welfare
PO-8	To engage in critical thinking by analyzing situations and constructing viable solutions with ability to work effectively with each .
PO-9	The Skills to recognize and evaluate the relationships between input and outputs, cost: benefit ratio in the Agricultural field to make effective decision .The Programme will enhance job opportunities and entrepreneurship development
PO-10	Self-critical opinion to solve the on farm problems on sustainable basis. The students will generate a culture of lifelong learning in an inclined environment to get personal achievement and professional ethics
PO-11:	Know the recent development, future possibilities in agriculture sector. Provide comprehensive knowledge of agriculture production.
PO-12:	The students will generate a culture of lifelong learning in an inclined environment to get personal achievement and professional ethics.

Programme Specific Outcomes (PSO):

PSO- 1	Interpreting the insect morphology ,anatomy, metamorphosis & bio-ecology as well as the basic principles, methods and strategies of Pest management in various crops of Economic importance.
PSO- 2	Associate with insect taxonomy, classification, physiology & nutritional aspects along with toxicology of insecticides and various insect pest of field crops
PSO-3	Link & integrate with bio-control ,pests of stored grains & horticultural & plantation crops, basics of host plant resistance, plant quarantine and insect vectors management.
PSO-4	Outline & summarize techniques in plant protection & memorize about insects of commercial significance, mite pests and insect pathogens

SCHOOL OF AGRICULTURAL SCIENCES

M.Sc.(Ag.) Entomology Degree Programme

'ACADEMIC RULES AND REGULATIONS'

(Effective from 2021-22)

01. Regulations

The Regulations provided herein shall apply to M.Sc. (Ag.) Entomology Degree Programme offered by the Shri Guru Ram Rai University.

02. Short Title and Commencement

These regulations shall be called "M.Sc. (Ag.) Entomology Degree Programme Academic Rules and Regulations 2020". They shall continue again from the academic year 2021-22.

03. Definitions & Abbreviations

3.1 'University' means the Shri Guru Ram Rai University, Dehradun.

3.2 'Curriculum' is a group of courses and other specified requirements for the fulfilment of the Degree Programme.

3.3 'Curricula and syllabi' It includes a list of approved courses for the Degree Programme wherein each course is identified by course code, outline of syllabus, credit assigned and semester wise distribution.

3.4 'Semester' means a period consisting of 90 working days inclusive of the mid-semester and practical examinations but excluding the study holidays and final theory examinations in each semester.

3.5 'Academic Year' means a period consisting of two consecutive semesters including the inter-semester break as announced by the University. The first year of study shall be the first and second semesters following student's admission. The second year of study shall be the third and fourth semesters.

3.6 'Course' is a teaching unit of a discipline to be covered within a semester as detailed in the Curricula and Syllabi issued by the University.

3.7 a.) Core Course: Core course means the list of courses specified by the University in the curricula and syllabi to be registered compulsorily by the students of M.Sc. (Ag.) Entomology Degree Programme.

b.) Elective course : Generally a course which can be chosen from a pool of courses and which may be very specific to the discipline/ subject of study or which provides an extended scope .

c.) Supporting Course : The course not entirely related to the major course. It could be any course considered relevant for Student's research work or necessary for building his/her overall competence.

3.8 Other Course: Other courses includes Master's seminar & Thesis Research to be registered compulsorily by the students of M.Sc. (Ag.) Entomology Degree Programme.

3.9 ‘A credit’ in theory means one hour of class room lecture and a credit in practical means two and half hour of laboratory or field work per week.

Explanation :

A 1+1 course (2 credits) means 1 hour theory and two and half hour practical per week.

A 0+1 course (1 credit) means two and half hour practical per week.

A 1+0 course (1 credit) means 1 hour theory per week.

3.10 ‘L’ is abbreviated for Lecture

‘T’ for Tutorial

‘P’ for Practical

‘C’ for Credit hours

04. Eligibility for admission to M.Sc. (Ag.) Entomology Degree Programme:

A candidate pass in the B.Sc. Agriculture/B.Sc.(Hons.)Agriculture/B.Sc. Horticulture /B.Sc.(Hons.) Horticulture/ B.Sc.Forestry or equivalent degree programme from a recognized college/Institute/University.

05. Admission Procedure: As per the University Norms.

06. System of Education

6.1 The system of education for M.Sc. (Ag.) Entomology Degree programme is Semester System with duration of two academic years (4 Semesters). The maximum duration permissible for a student shall be 06 consecutive semesters (3 years). If a student at any stage of his/her course is found unable to complete it within the said time, he/she shall not be allowed to continue the studies further.

6.2 The date of commencement and closure of semesters as well as inter-semester break and schedule of final theory examinations shall be announced by the University.

6.3 Credits are assigned to each course in M.Sc. (Ag.) Entomology on the basis of the number of theory classes or lectures and Practical classes or laboratory work or field work as well as other form of learning required to complete the course content in a scheduled period as decided by the University.

6.4 An academic calendar shall be prepared by the University for every semester indicating the date of commencement and closure of semesters, date of mid semester examinations, final practical and theory examinations, inter semester break and holidays.

6.5 Summary of Credits in M.Sc. (Ag.) Entomology

Semester	Core course	Elective courses	Supporting courses	Seminar	Thesis Research	Total credits
I	9	-	4	-	-	13
II	12	-	-	-	-	12
III	9	2	-	-	-	11
IV	-	3	3	1	20	27
Grand Total						63

6.6 A student must successfully complete a total of 63 credits which include 30 credits for core courses , 05 credits for elective courses, 07 credits for supporting courses,01 credit for seminar & 20 credits for thesis research for the Curriculum requirement of M.Sc. (Ag.) Entomology Degree Programme.

6.7 A course shall be offered only once in an academic year during the semester as listed in the course curricula and syllabi.

07. The Medium of Instruction: The medium of instruction will be in English.

08. Reservation: The reservation will be as per the State Government rules / University Norms and Policies.

09. Total Seats: The total seats in M.Sc. (Ag.) Entomology degree programme will be as per the guidelines of the University.

10. Fee structure: As decided by the University.

11. Attendance: As per University Norms.

12. Examination and Evaluation: As per University Norms with following guidelines:

12.1 The medium of Examination:

The medium of Examination will be English.

12.2 Duration of examinations: The examinations shall be conducted according to the description given below:

Examination	Courses with theory and practical	Courses with only theory	Courses with only practical
Mid-Semester Examination (internal)	1.0 hour	1.0 hour	--
End Semester Exam	2.5 hours	2.5 hours	--
Practical Examination	3.0 hours	--	3.0 hours

12.3 Distribution of marks in External and Internal Exams:

(a) Courses with Theory and Practical both (Maximum Marks 100):

- End Semester Exam (50% or 50 marks) in each paper
- Internal Mid-term theory Examinations (30% or 30 marks) in each paper
- Practical Examination (20% or 20 marks) in each paper

(b) Courses with only Theory (Maximum Marks 100):

- End Semester Exam (50% or 50 marks) in each paper
- Internal Mid-term theory Exams (40% or 40 marks) + Assignment (10% or 10 marks) in each paper

(c) Courses with only Practical (Maximum Marks 100):

- Internal Practical Examination (100% or 100 marks) in each paper

12.4 Assessment Norms: As per University Norms

12.5 Question paper pattern:

(a) End Semester Exam for courses with theory and practical:

The question paper pattern for External theory Examination (Maximum Marks: 50) for courses with theory and practical is given below:

SECTION	Type of question	Number of Questions Given	Number of questions to be answered	Mark per question	Total Marks
A	Objectives	10	10	01	10
B	Short answer type	06	04	05	20
C	Long answers type	04	02	10	20
Total					50

(b) End Semester Exam for courses with theory only:

The question paper pattern for External theory Examinations (Maximum marks: 50) for courses with only theory shall be as per given in section 12.5 (a).

(c) Mid-term & Practical Exam:

As per the guidelines of University

(d) Master's Thesis evaluation: On successful completion, evaluation and submission of Master's thesis , satisfactory grade will be awarded.

13. Submission of Master's Thesis: As per University Norms.

14. Promotion of students to next semester: As per the University Norms and policies.

15. Approval of Final Results, Award of Degree and Issue of Provisional Certificates and Transcripts or Mark sheet: As per University Norms

16. Removal of Difficulties:

16.1 If any difficulty arises in giving effect to the Provisions of these regulations, the University may issue necessary orders which appear to be necessary or expedient for removing the difficulty.

16.2 Every order issued by the University under this provision shall be laid before the Academic Council of the University immediately after the issuance.

16.3 Notwithstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary.

COURSE CURRICULUM**M.Sc. (Ag.) Entomology**

A. Core Courses			
S. No.	Course Number	Name of the Courses	Credit Hours
1.	MSEC-102	Insect Morphology	3 (2-0-1)
2.	MSEC-103	Insect Ecology	3 (2-0-1)
3.	MSEC-104	Principles of Integrated Pest Management	3 (2-0-1)
4.	MSEC-201	Insect Taxonomy	3 (2-0-1)
5.	MSEC-202	Insect Physiology and Nutrition	3 (2-0-1)
6.	MSEC-203	Toxicology of Insecticides	3 (2-0-1)
7.	MSEC-204	Pests of Field Crops	3 (2-0-1)
8.	MSEC-301	Biological Control of Crop Pests and Weeds	3 (2-0-1)
9.	MSEC-302	Storage Entomology	3 (2-0-1)
10.	MSEC-303	Pests of Horticultural and Plantation Crops	3 (2-0-1)
Total			30
B. Basic Supporting Courses			
11.	MSEC-101	Statistical Methods & Experimental Designs	04 (3-0-1)
12.	MSEC-401	Techniques in Plant Protection	03 (2-0-1)
Total			07
C.Seminar			
13.	MSES-405	Master's Seminar	01(1-0-0)
D. Research			
14.	MSET-406	Master's Thesis Reseach	20
E. Elective Courses			
15.	-	From the list of Elective courses	05
Grand Total			63

List of Elective Courses:

S.No.	Course	Course Title	Credit hours
1.	MSEE-304	Plant Resistance to Insects	2 (1-0-1)
2.	MSEE-305	Plant quarantine	2 (2-0-0)
3	MSEE-306	Insect vectors of Plant viruses and other Pathogens	2(1-0-1)
4	MSEE-402	Commercial Entomology	3 (2-0-1)
5	MSEE-403	General Acarology	3 (2-0-1)
6.	MSEE-404	Insect Pathology	3 (2-0-1)

Semester-wise distribution of courses

M.Sc. (Ag.) Entomology

First Semester:

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation Scheme (MM)		Subject Total (MM)
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory+ Practical										
1	Basic Supporting	MSEC-101	Statistical Methods & Experimental Designs	3		1	4	50	50	100
2	Core	MSEC-102	Insect Morphology	2		1	3	50	50	100
3	Core	MSEC-103	Insect Ecology	2		1	3	50	50	100
4	Core	MSEC-104	Principles of Integrated Pest Management	2		1	3	50	50	100
Total Courses:				Total Credit hours :						
Core Course : 03				Core Course : 09						
Supporting : 01				Supporting : 04						
Elective : Nil				Elective : Nil						
Total : 04				Total : 13						

Abbreviations.: L – Lecture, T – Tutorial, P – Practical, C – Credit hours

Semester-wise distribution of courses

M.Sc. (Ag.) Entomology

Second Semester :

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation Scheme (MM)		Subject Total (MM)
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory+ Practical										
1	Core	MSEC-201	Insect Taxonomy	2		1	3	50	50	100
2	Core	MSEC-202	Insect Physiology and Nutrition	2		1	3	50	50	100
3	Core	MSEC-203	Toxicology of Insecticides	2		1	3	50	50	100
4	Core	MSEC-204	Pests of Field Crops	2		1	3	50	50	100
Total Courses: Core Course : 04 Supporting : Nil Elective : Nil Total : 04				Total Credit hours : Core Course : 12 Supporting : Nil Elective : Nil Total : 12						

Abbreviations.: L – Lecture, T – Tutorial, P – Practical, C – Credit hours

Semester-wise distribution of courses

M.Sc. (Ag.) Entomology

Third Semester:

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation Scheme (MM)		Subject Total (MM)
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory + Practical										
1	Core	MSEC-301	Biological Control of Crop Pests and Weeds	2		1	3	50	50	100
2	Core	MSEC-302	Storage Entomology	2		1	3	50	50	100
3	Core	MSEC-303	Pests of Horticultural and Plantation Crops	2		1	3	50	50	100
Elective courses (Students have to select any one)										
4	Elective	MSEE-304	Plant Resistance to Insects	1		1	2	50	50	100
5	Elective	MSEE-305	Plant quarantine	2		0	2	50	50	100
6	Elective	MSEE-306	Insect vectors of Plant viruses and other Pathogens	1		1	2	50	50	100
Total Courses:				Total Credit hours :						
Core Course : 03				Core Course : 09						
Supporting : Nil				Supporting : Nil						
Elective : 01				Elective : 02						
Total : 04				Total : 11						

Abbreviations.: L – Lecture, T – Tutorial, P – Practical, C – Credit hours

Semester-wise distribution of courses

M.Sc. (Ag.) Entomology

Fourth Semester:

S. No.	Course Category	Course Code	Course Name	Periods				Evaluation Scheme (MM)		Subject Total (MM)
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory+ Practical										
1	Basic supporting	MSEC-401	Techniques in Plant Protection	2		1	3	50	50	100
2.	Seminar	MSES-405	Master's Seminar	1		0	1	100	-	100
3.	Research	MSET-406	Master's Thesis Reseach	0		20	20	Satisfactory grade is given after successful completion of research work		
Elective courses (Students have to select any one)										
4	Elective	MSEE-402	Commercial Entomology	2		1	3	50	50	100
5	Elective	MSEE-403	General Acarology	2		1	3	50	50	100
6	Elective	MSEE-404	Insect Pathology	2		1	3	50	50	100
Total Courses:				Total Credit hours :						
Core Course : Nil				Core Course : Nil						
Supporting : 01				Supporting : 03						
Elective : 01				Elective : 03						
Seminar : 01				Seminar : 01						
Research : 01				Research : 20						
Total : 04				Total : 27						

Abbreviations.: L – Lecture, T – Tutorial, P – Practical, C – Credit hours

DESCRIPTION OF COURSES

“SYLLABUS”

M.Sc. (Ag.) Entomology

Semester – I

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-101	Credit	04
Year/Sem	1/I	L-T-P	3-0-1
Course Name	Statistical Methods & Experimental Designs		
Course Objectives:			
<ol style="list-style-type: none"> 1. To educate basics terms used in collection, classification, presentation and analysis of data, descriptive statistics, parametric and non-parametric tests, etc. 2. To develop understanding of use of various formulas, principles and methods of statistical calculations used in agriculture. 3. To develop skills in methods of collection of any type of data, classification of data, presentation of data, analysis of data, descriptive statistics, parametric and non-parametric tests, etc. 4. To analyze results of statistical calculations and their validation. 			
UNIT I			
Processing of data: Classification and tabulation of statistical data by categories and measurements, graphical and diagrammatic representation-histogram. Frequency polygon, frequency curve and cumulative frequency curves.			
UNIT II			
Measure of location and dispersion: Mean, median, mode, partition values (quartiles, deciles and percentiles). Range, quartile deviation, mean deviation about mean and median, standard deviation coefficient of variation, moment kurtosis.			
UNIT- III			
Probability & distribution: Random experiment, sample space (discrete case only), events mathematical and statistical definition of probability, random variable (discrete and continuous), bermoulli trials, binomial distn. posson distn. Poision distn as a limiting case of the bionominal distn, normal sistn, properties of the above distributions and fitting with available date, Test for their goodness of fit.			
UNIT-IV			
Correlation and regression : Bivariate dats, bivariate frequency distn, correlation coefficient, rank correlation, Regression lines, regression coefficients and their relation with correlation coefficient, Multiple regression, multiple and partial correlation coefficients.			
UNIT-V			
Estimation: Concept of population and sample; parameters and statistics: criteria for a good estimator unbiasedness, consistency of population mean and its confidence internal in the normal case. Testing of hypothesis: Null and alternative hypotheses, two type of errors, level of significance, power of the test, one tailed and two tailed tests.			
UNIT-VI			
Tests of significance: (a) large sample tests for mean & equality of means of two populations (2 tests). Student’s statistic and its use of testing the mean equality of means of two populations (with independent and paired observations) correlation coefficient and regression coefficients. (b) Chi-Square statistics and its use as a test of goodness of fit, independence of attributes (contingency table) with Yates correction, and testing for the variance of a population. (c) Fishers statistic and its use in testing the equality of two variances and homogeneity of means (analysis of variance).			
UNIT-VII			

Analysis of variance and covariance (ANOVA and ANCOVA): Analysis of variance and covariance with one way and two-way classifications (one observation per cell). Bartlettin test for testing the homogeneity of variances.

UNIT-VIII

Design of experiments: Need: uniformity trials, Principles of experimental design replication, randomization and local control, (a) Completely Randomized Design, Randomized Block Design and Latin Square Designs and their analysis, missing plot technique in RBD. (b) Simple factorial experiments of the type 22, 33, 24, 32, confounding in factorial experiments. (c) Split-plot experiments.

Practical :

1. Presentation of data-tabulation, histograms and frequency polygons
2. Calculation of mean, mode, standard deviation, skewness and kurtosis
3. Calculation of expected frequencies in binomial, posson and normal distributions testing the observed results against expected frequencies
4. Tests of significance as prescribed in theory
5. Regression and correlation coefficients and their significance
6. Analysis of variance for different designs prescribed
7. Analysis of covariance

Course Outcomes (COs): Upon successful completion of the course a student will be able to:

CO-1: Define the basic concept of statistics, t-test, f-test, hypothesis, sampling etc.

CO-2: Understand the role of statistics in research experiments.

CO-3: Choose and prepare experimental designs.

CO-4: Analyze the results of statistical calculations and their validation

CO-5: Compare different statistical methods used in agricultural research

CO-6: Design new experimental designs

Suggested readings:

- Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan Chand and Sons, New Delhi
- Nageswara Rao, G. 2007. Statistics for Agricultural Sciences. B.S. Publications, Hyderabad.
- Panse, V. G. and Sukhatme, P. V. 1961. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research.
- S.R.S. Chandel. 2007. A Handbook of Agricultural Statistics. Anchal Prakashan Madir, Kanpur-208005.

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	1	1	-	1	1	2	1	-	-	-	-	1	-	1
CO-2	1	1	1	2	1	2	-	1	1	1	2	1	-	2	-	3
CO-3	2	2	2	1	-	1	-	2	2	3	1	2	2	1	-	1
CO-4	1	1	1	1	-	1	1	1	1	-	-	-	-	1	-	-
CO-5	1	1	2	2	1	2	1	1	1	2	2	1	1	2	1	3
CO-6	1	2	2	2	1	1	3	1	1	1	2	1	-	2	-	3
Average	1.3	1.3	1.5	1.5	1.0	1.3	1.5	1.3	1.2	1.75	1.75	1.25	1.5	1.5	1.0	2.2

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-102	Credit	3 (2+1)
Year/Sem	1/I	L-T-P	2-0-1
Course Name	Insect Morphology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To familiarize with insect's external morphology 2. To acquaint with different types of metamorphosis found in insects 3. To develop understanding of different types of sense organs found in insects 4. To learn about anatomy of different systems of insects 			
UNIT I			
Principles, utility and relevance, insect body wall structure, cuticular outgrowths, colouration and special integumentary structures in insects, body tagmata, sclerites and segmentation, Head- Origin, structure and modification; types of mouthparts and antennae, tentorium and neck sclerites,			
UNIT II			
Thorax- Areas and sutures of tergum, sternum and pleuron, pterothorax; Wings: structure and modifications, venation, wing coupling apparatus and mechanism of flight; Legs: structure and modifications			
UNIT- III			
Abdomen-Segmentation and appendages; Genitalia and their modifications; embryonic and post-embryonic development; Types of metamorphosis. Insect sense organs (mechano-, photo- and chemo-receptors)			
UNIT-IV			
Structure of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands			
Practical :			
<ol style="list-style-type: none"> 1. Study of insect segmentation & various tagmata 2. Preparation of permanent mounts of different Types of heads & its appendages 3. Preparation of permanent mounts of different modifications of legs 4. Study & preservation of different modifications of wings 5. Preparation of permanent mounts of different abdominal appendages including geitalia 6. Dissection of insects to study comparative anatomical details of digestive system 7. Dissection of insects to study comparative anatomical details of excretory system 8. Dissection of insects to study comparative anatomical details of respiratory system 9. Dissection of insects to study comparative anatomical details of nervous system 10. Study different sense organs of insect 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Relate & recall basic terms, facts & concepts of insect's external morphology			
CO-2: Infer with different types of metamorphosis found in insects			
CO-3: Organize with different types of sense organs found in insects			
CO-4: Compare anatomy of different systems of insects			
CO-5: Justify application of insect's external morphology in agriculture			
CO-6: Synthesize some techniques to study anatomical details of insects			
Suggested readings:			
<ul style="list-style-type: none"> • Chapman RF.2013. The Insects: Structure and Function. Cambridge Univ. Press, Cambridge. • Snodgrass RE. 1993. Principles of Insect Morphology. Cornell Univ. Press, Ithaca. • Richards OW & Davies RG. 1977. Imm's General Text Book of Entomology. 10th Ed. Chapman & Hall, London. • Evans JW. 2004. Outlines of Agricultural Entomology. Asiatic Publ., New Delhi 			

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	2	1	-	-	-	2	1	1	-	-	2	1	-	-	-
CO-2	1	-	1	-	1	1	2	1	1	-	1	2	1	1	1	1
CO-3	1	1	-	-	1	1	2	2	-	-	1	2	1	-	1	-
CO-4	1	2	-	-	1	2	1	1	1	1	1	1	1	-	1	-
CO-5	1	1	1	1	1	1	1	1	2	1	1	-	1	1	1	1
CO-6	1	-	1	1	1	1	2	1	1	2	1	1	1	1	1	1
Average	1.0	1.5	1.0	1.0	1.0	1.2	1.6	1.2	1.2	1.3	1.0	1.6	1.0	1.0	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-103	Credit	3(2+1)
Year/Sem	1/I	L-T-P	2-0-1
Course Name	Insect Ecology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To educate about the history ,basic concepts of insect's ecology with principles and law regulating Abundance,distribution and diversity of insects 2. To aware about the factors of population dynamics and Seasonality of insects 3. To learn about nutritional Ecology and different types of interactions found in natural insect population 4. To study about defense mechanisms adopted by insects , community ecology & concept of insect diversity 			
UNIT I			
History and Definition. Basic Concepts. Organisation of the Biological world. Plato's Natural Balance vs Ecological Dynamics as the modern view. Abundance and diversity of insects, Estimates and Causal factors. Study of abundance and distribution and relation between these two. Basic principles of abiotic factors and their generalised action on insects. Implications for abundance and distribution of organisms including insects- Law of the Minimum, Law of Tolerance, and biocoenosis. Systems approach to ecology, Basic concepts of abundance- Model vs Real world. Population growth- basic models – Exponential vs Logistic models. Discrete vs Continuous growth models. Concepts of Carrying capacity, Environmental Resistance and Optimal yield. Vital Statistics- Life Tables and their application to insect biology. Survivorship curves. Case studies of insect life tables			
UNIT II			
Population dynamics- Factors affecting abundance- Environmental factors, dispersal and migration, Seasonality in insects. Classification and mechanisms of achieving different seasonality- Diapause (Quiescence) - aestivation, hibernation.			
UNIT- III			
Biotic factors- Food as a limiting factor for distribution and abundance, Nutritional Ecology. Food chain- web and ecological succession. Interspecific interactions-Basic factors governing the interspecific interactions- Classification of interspecific interactions - The argument of cost-benefit ratios. Competition- Lotka-Volterra model, Concept of niche- ecological homologues, competitive exclusion. Prey-predator interactions- Basic model- Lotka-Volterra Model, Volterra's principle. Functional and numerical response.			
UNIT-IV			
Defense mechanisms against predators/parasitoids- Evolution of mimicry, colouration, concept of predator satiation; evolution of life history strategies, Community ecology-Concept of guild, Organisation of communities- Hutchinson Ratio, May's d/w , Relation between the two and their association with Dyar's Law and Przibram's law. Relative distribution of organisms, Concept of diversity- the Wallacian view. Assessment of diversity. Diversity- stability debate, relevance to pest management. Pest management as applied ecology.			
Practical :			
<ol style="list-style-type: none"> 1. Types of distributions of organisms 2. Methods of sampling insects, estimation of densities of insects and understanding the distribution parameters- 3. Assessment of prey-predator densities from natural systems and understanding the correlation between the two 4. Assessing and describing niche of some insects of a single guild. 			

5. Calculation of some diversity indices
6. Field visits to understand different ecosystems and to study insect occurrence in these systems.

Course Outcomes (COs): Upon successful completion of the course a student will be able to:

CO-1: Describe the history ,basic concepts of insect's ecology with principles and law regulating Abundance,distribution and diversity of insects

CO-2: Explain the factors of population dynamics and Seasonality of insects

CO-3: Utilize basic concepts of nutritional Ecology and different types of interactions found in natural insect population

CO-4: Simplify defense mechanisms adopted by insects, community ecology & concept of Insect diversity

CO-5: Compare different theories, concepts ,principles & methods of insect ecology

CO-6: Improve methods adopted in insect ecological studies

Suggested readings:

- Chapman JL & Reiss MJ. 2006. Ecology: Principles & Applications. 2 Cambridge. Ed. Cambridge Univ. Press
- Southwood TRE & Henderson PA. 2000. Ecological Methods. 3rd Ed. Methuen & Co. Ltd., London.
- Price PW. 1997. Insect Ecology. 3rd Ed. John Wiley, New york.
- Speight MR, Hunta MD & Watt AD. 2006. Ecology of Insects: Concepts and Application. Elsevier Science Publ., The Netherlands

CO-PO/PSO Mapping :

COs/POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	1	1	1	-	1	1	2	1	-	1	2	-	1	1	-
CO-2	3	1	1	2	1	2	-	1	1	1	-	1	-	2	2	1
CO-3	1	2	2	1	-	1	-	2	2	3	-	2	2	1	1	-
CO-4	-	1	1	1	-	1	1	1	1	-	1	1	-	1	1	-
CO-5	3	1	1	2	3	2	-	1	1	1	1	1	2	2	2	1
CO-6	1	1	1	1	1	1	1	2	2	3	1	2	1	1	-	1
Average	1.8	1.2	1.2	1.3	1.6	1.3	1.0	1.5	1.3	2.0	1.0	1.5	1.6	1.3	1.2	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-104	Credit	3(2+1)
Year/Sem	1/I	L-T-P	2-0-1
Course Name	Principles of Integrated Pest Management		
Course Objectives:			
<ol style="list-style-type: none"> 1. To update knowledge on history ,origin & the basic Concept of pests & IPM 2. To create skill of executing different tools of pest management and their integration 3. To acquaint with Sampling, survey, surveillance and forecasting of pest population with constraints in IPM. 4. To remember case studies of IPM & different Pest control appliances 			
UNIT I			
History and origin, definition and evolution of various related terminologies. Concept of IPM. Economic decision levels of insect pest population. Insect dominance, increase in agriculture pest problem, pest outbreak and factors affecting it; Categories of pest,			
UNIT II			
Tools of pest management and their integration- legislative, cultural, physical and mechanical methods, host plant resistance, biological control, semiochemicals, botanicals and chemical control, insecticide resistance management;			
UNIT- III			
Sampling, survey, surveillance and forecasting. Controversies, criticism and constraints in IPM.			
UNIT-IV			
Case studies of successful IPM programmes. Pest control appliances and their maintenance.			
Practical :			
<ol style="list-style-type: none"> 1. Characterization of agro-ecosystems 2. sampling methods and factors affecting sampling 3. population estimation methods 4. crop loss assessment 5. Computation of EIL and ETL; 6. designing and implementing IPM system 7. Use of pest control appliances and their maintenance. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Recall history ,origin,definitions & the basic Concept of pests & IPM			
CO-2: Demonstrate different tools of pest management and their integration			
CO-3: Use methods of sampling, survey, surveillance and forecasting of pest population with constraints in IPM.			
CO-4: Analyze case studies of IPM & different Pest control appliances			
CO-5: Select the correct method for pest management			
CO-6: Propose new tools & techniques in IPM.			
Suggested readings:			
<ul style="list-style-type: none"> • Dhaliwal GS & Arora R. 2003. Integrated Pest Management – Concepts and Approaches. Kalyani Publ., New Delhi. • Pedigo RL. 2002. Entomology and Pest Management. 4th Ed. Prentice Hall, New Delhi. • Norris RF, Caswell-Chen EP & Kogan M. 2002. Concepts in Integrated Pest Management. Prentice Hall, New Delhi. • Horowitz AR & Ishaaya I. 2004. Insect Pest Management: Field and Protected Crops. Springer, New Delhi. 			

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	-	-	-	2	2	1	-	3	1	2	1	1	-	-	1
CO-2	3	2	1	1	-	1	2	2	3	2	1	2	2	2	1	2
CO-3	3	2	1	1	1	1	2	2	2	-	1	2	1	2	1	1
CO-4	2	2	1	-	2	1	2	2	1	1	1	2	2	2	1	-
CO-5	1	1	2	2	1	1	2	1	1	2	1	-	1	-	1	1
CO-6	2	2	1	2	1	1	2	2	1	2	1	2	2	1	1	1
Average	2.0	1.8	1.2	1.5	1.4	1.2	1.8	1.5	1.8	1.6	1.2	1.8	1.5	1.75	1.0	1.2

SYLLABUS

M.Sc. (Ag.) ENTOMOLOGY

Semester – II

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-201	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Insect Taxonomy		
Course Objectives:			
<ol style="list-style-type: none"> To retrieve about evolutionary history , phylogeny & basic classification of Super class Hexapoda To outline different insect orders & families of economic importance of Subclass Apterygota To mind map distinguishing characters, general biology, habits and habitats of Orthopteroid , Blattoid & Hemipteroid orders & related families To Articulate with distinguishing characters, general biology, habits and habitats of Coleopteroid Orders: Hymenopteroid Orders & related families 			
UNIT I			
Brief evolutionary history of Insects- introduction to phylogeny of insects and Major Classification of Super class Hexapoda – Classes – Ellipura (Collembola, Protura), Diplura and Insecta-,			
UNIT II			
Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families of orders Collembola, Protura, Diplura. Class Insecta: Subclass Apterygota – Archaeognatha, Thysanura.			
UNIT- III			
Subclass: Pterygota, Division Palaeoptera– Odonata and Ephemeroptera. Division: Neoptera: Subdivision: Orthopteroid and Blattoid Orders (=Oligoneoptera: Plecoptera, Blattodea, Isoptera, Mantodea, Grylloblattodea, Dermaptera, Orthoptera, Phasmatodea, Mantophasmatodea, Embioptera, Zoraptera), Subdivision: Hemipteroid orders (=Paraneoptera): Psocoptera, Phthiraptera, Thysanoptera and Hemiptera, Distinguishing characters, general biology, habits and habitats of Insect orders and economically important families contained in them (Continued).			
UNIT-IV			
Division Neoptera– Subdivision Endopterygota, Section Neuropteroid- Coleopteroid Orders: Strepsiptera, Megaloptera, Raphidioptera, Neuropterand Coleoptera, Section Panorpid Orders Mecoptera, Siphonaptera, Diptera, Trichoptera, Lepidoptera, and Section Hymenopteroid Orders: Hymenoptera.			
Practical :			
<ol style="list-style-type: none"> Field visits to collect insects of different orders Study of Orders of insects and their identification using taxonomic keys Study of important families of insects orders Odonata, Orthoptera, Blattodea, Mantodea, Study of important families of insects orders Isoptera, Hemiptera, Thysanoptera, Study of important families of insects orders Neuroptera, Coleoptera, Diptera, Study of important families of insects orders Lepidoptera & Hymenoptera. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Memorize evolutionary history , phylogeny & basic classification of Super class Hexapoda			
CO-2: Compare with different insect orders & families of economic importance of Subclass Apterygota			

CO-3: Make use of distinguishing characters, general biology, habits and habitats of Orthopteroid , Blattoid & Hemipteroid orders & related families
 CO-4: Contrast distinguishing characters, general biology, habits and habitats of Coleopteroid Orders: Hymenopteroid Orders & related families
 CO-5: Prioritize basic features of different insect orders of economic importance
 CO-6: Construct new keys & methods for insect identification.

Suggested readings:

- Blackwelder RE. 1967. *Taxonomy - A Text and Reference Book*. John Wiley & Sons, New York.
- Mayr E. 1971. *Principles of Systematic Zoology*. Tata McGraw-Hill, New Delhi.
- Ross HH.1974. *Biological Systematics*. Addison Wesley Publ. Co.
- Freeman S & Herron JC. 1998. *Evolutionary Analysis*. Prentice Hall, New Delhi
- Timothy Gibb & Christian Oseto.2019. *Insect Collection and Identification*. Academic Press.
- Robert G. Footitt & Peter H. Adler .2018. *Insect Biodiversity: Science and Society*, Wiley-Blackwel

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	-	-	-	2	2	1	-	3	1	2	1	1	-	-	1
CO-2	3	2	1	1	-	1	2	2	3	2	1	2	2	2	1	2
CO-3	3	2	1	1	1	1	2	2	2	-	1	2	1	2	1	1
CO-4	2	2	1	-	2	1	2	2	1	1	1	2	2	2	1	-
CO-5	1	1	2	2	1	1	2	1	1	2	1	-	1	-	1	1
CO-6	2	2	1	2	1	1	2	2	1	2	1	2	2	1	1	1
Average	2.0	1.8	1.2	1.5	1.4	1.2	1.8	1.5	1.8	1.6	1.2	1.8	1.5	1.75	1.0	1.2

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-202	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Insect Physiology and Nutrition		
Course Objectives:			
<ol style="list-style-type: none"> 1. To associate with the basic concept of scope and importance of insect physiology and nutrition 2. To sketch with the physiology of different systems of insects 3. To relate about the physiology of integument , metamorphosis and diapauses 4. To develop know –how about the role of Insect nutrition,artificial diet & micro- organisms in physiology 			
UNIT I			
Scope and importance of insect physiology and nutrition,			
UNIT II			
Physiology of different systems- digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive, musculature, endocrine and exocrine glands,			
UNIT- III			
Thermodynamics; physiology of integument, moulting; growth, metamorphosis and diapauses,			
UNIT-IV			
Insect nutrition- role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra- cellular micro- organisms and their role in physiology; artificial diets,			
Practical :			
<ol style="list-style-type: none"> 1. Determination of chitin in insect cuticle 2. Examination of insect haemocytes 3. Determination of respiratory quotient 4. Preparation and evaluation of various diets 5. Consumption, utilization and digestion of natural and artificial diets. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Retrieve the basic concept ,terms used in insect physiology and nutrition			
CO-2: Infer with the physiology of different systems of insects			
CO-3: Model the physiology of integument , metamorphosis and diapauses			
CO-4: Analyze the role of Insect nutrition,artificial diet & micro- organisms in physiology			
CO-5: Assess the validity of different concepts & facts related to insect physiology.			
CO-6: Modify methods & techniques used in insect physiological studies.			
Suggested readings :			
<ul style="list-style-type: none"> • Chapman RF.2004. Insects: Structure and Function. ELBS Ed., London. • Wigglesworth VB.1984. Insect Physiology. 8th Ed. Chapman & Hall, New York. • Patnaik BD. 2002. Physiology of Insects. Dominant, New Delhi. • Kerkut GA & Gilbert LI. 1985. Comprehensive Insect Physiology, Biochemistry and Pharmacology. Vols. I-XIII. Pergamon Press, New York. 			

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	2	1	-	1	1	-	-	-	-	1	-	1	1	1	-
CO-2	1	2	2	-	1	1	1	1	1	1	1	1	1	2	1	-
CO-3	1	1	1	1	1	1	1	1	-	-	1	1	2	1	1	1
CO-4	1	3	1	-	-	1	2	1	1	2	1	2	1	1	1	-
CO-5	3	2	3	1	1	1	1	1	1	-	-	1	2	2	-	1
CO-6	1	1	1	2	1	2	1	1	-	2	1	2	1	1	1	1
Average	1.3	1.6	1.5	1.3	1.0	1.2	1.2	1.0	1.0	1.6	1.0	1.4	1.3	1.3	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-203	Credit	3(2+1)
Year/Sem	1/II	L-T-P	2-0-1
Course Name	Toxicology of Insecticides		
Course Objectives:			
<ol style="list-style-type: none"> 1. To highlight about introduction, history and classification of insecticides 2. To Identify & summarize the basic properties, structure & mode of action of important insecticides 3. To gain knowledge on basic principles of toxicology & insecticides resistance 4. To understand status of insecticide residues, insecticide Act & insecticide poisoning 			
UNIT I			
Definition and scope of insecticide toxicology; history of chemical control; pesticide use and pesticide industry in India, classification of insecticides and acaricides based on mode of entry, mode of action and chemical nature.			
UNIT II			
Structure and mode of action of organo- chlorines, organophosphates, carbamates, pyrethroids, tertiary amines, neonicotinoids, oxadiazines, phenyl pyrozoles, insect growth regulators, microbials, botanicals, new promising compounds, etc.,			
UNIT- III			
Principles of toxicology; evaluation of insecticide toxicity; joint action of insecticides- synergism, potentiation and antagonism; factors affecting toxicity of insecticides; insecticide compatibility, selectivity and phytotoxicity, Insecticide metabolism; pest resistance to insecticides; mechanisms and types of resistance; insecticide resistance management and pest resurgence,			
UNIT-IV			
Insecticide residues, their significance and environmental implications. Insecticide Act, registration and quality control of insecticides; safe use of insecticides; diagnosis and treatment of insecticide poisoning			
Practical			
<ol style="list-style-type: none"> 1. Study of insecticide formulations and mixtures 2. Quality control of pesticide formulations 3. laboratory and field evaluation of of insecticides for bioefficacy 4. Study of bioassay techniques 5. Probit analysis 6. Toxicity to beneficial insects. 7. Working out doses and concentrations of pesticides; 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Omit basic concepts, definitions & techniques used in insecticide toxicology.			
CO-2: Summarize the basic properties, structure & mode of action of important insecticides			
CO-3: Use the knowledge regarding basic principles of toxicology & insecticides resistance			
CO-4: Examine insecticide residues, insecticide Act & insecticide poisoning.,			
CO-5: Decide the correct use of insecticides			
CO-6: Design new & better methods & techniques for insect toxicological studies			

Suggested readings:

- Gupta HCL.1999. Insecticides: Toxicology and Uses. Agrotech Publ., Udaipur.
- Ishaaya I & Degheele (Eds.). 1998. Insecticides with Novel Modes of Action. Narosa Publ. House, New Delhi
- Matsumura F. 1985. Toxicology of Insecticides. Plenum Press, New York.
- Perry AS, Yamamoto I, Ishaaya I & Perry R. 1998. Insecticides in Agriculture and Environment. Narosa Publ. House, New Delhi.
- Simon J. Yu.2015.The Toxicology and Biochemistry of Insecticides. CRC Press .
- Singh SB,Upadhyay SN & Badaya AK.2019.Toxicology of Insecticides . Biotech Books.

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-		-	-	-	-	-	-	2	2	-	-
CO-2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO-3	1	1	2	-	-	1	-	-	-	-	-	2	2	-	-	2
CO-4	1	1	1	1	-	1	-	-	-	-	2	1	-	-	-	-
CO-5	-	-	-	-	2	-	2	3	2	2	-	2	-	-	2	-
CO-6	-	-	-	-	-	-	-	2	1	-	2	1	-	-	2	-
Average	1.3	1.25	1.5	1	2	1.3	2	2.5	1.5	2	2	1.5	2	1.5	2	2

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-204	Credit	3(2+1)
Year/Sem	2/II	L-T-P	2-0-1
Course Name	Pests of Field Crops		
Course Objectives:			
<ol style="list-style-type: none"> 1. To develop understanding of systematic position , identification, distribution, host-range, biology, damage and management of cereals ,millets and pulses pests 2. To generate know-how about systematic position , identification, distribution, host-range, biology, damage and management of tobacco, oilseeds and fibre crops pests 3. To familiarize with systematic position , identification, distribution, host-range, biology, damage and management of forage crops & sugarcane pests 4. To categorize systematic position , identification, distribution, host-range, biology, damage and management of Polyphagous pests & non-insect pests. 			
UNIT I			
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors of cereals ,millets and pulses			
UNIT II			
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors of tobacco, oilseeds and fibre crops			
UNIT- III			
Systematic position, identification, distribution, host-range, bionomics, nature and extent of damage, seasonal abundance and management of insect and mite pests and vectors of forage crops & sugarcane			
UNIT-IV			
Polyphagous pests: grasshoppers, locusts, termites, white grubs, hairy caterpillars, and non-insect pests (mites, birds, rodents, snails, slugs etc.),			
Practical			
<ol style="list-style-type: none"> 1. Field visits, collection and identification of important pests and their natural enemies 2. Detection and estimation of infestation and losses in different crops 3. Study of life history of important insect pests of cereals 4. Study of life history of important insect pests of pulse crops 5. Study of life history of important insect pests of oil seed crops 6. Study of life history of important insect pests of fibre crops 7. Study of life history of important insect pests of sugar crops 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Find & gather information on systematic position , identification, distribution, host-range, biology, damage and management of cereals ,millets and pulses pests			
CO-2: Associate with systematic position , identification, distribution, host-range, biology, damage and management of tobacco, oilseeds and fibre crops pests			
CO-3: Model systematic position , identification, distribution, host-range, biology, damage and management of forage crops & sugarcane pests			
CO-4: Distinguish systematic position , identification, distribution, host-range, biology, damage and management of Polyphagous pests & non-insect pests			
CO-5: Interpret established studies regarding to pests of field crops			
CO-6: Formulate new concepts in the field of pest management			

Suggested readings:

- Evans JW. 2005. Insect Pests and their Control. Asiatic Publ., New Delhi
- Atwal,A.S. & dhaliwal G.S.2018.Agricultural Pests of South Asia and their Management. Kalyani
- Nair MRGK. 1986. Insect and Mites of Crops in India. ICAR, New Delhi.
- Atwal AS, Dhaliwal GS & David BV. 2001. Elements of Economic Entomology. Popular Book Depot, Chennai

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	1	2	1	-	1	1	-	-	-	-	1	-	1	1	1	-
CO-2	1	2	2	-	1	1	1	1	1	1	1	1	1	2	1	-
CO-3	1	1	1	1	1	1	1	1	-	-	1	1	2	1	1	1
CO-4	1	3	1	-	-	1	2	1	1	2	1	2	1	1	1	-
CO-5	3	2	3	1	1	1	1	1	1	-	-	1	2	2	-	1
CO-6	1	1	1	2	1	2	1	1	-	2	1	2	1	1	1	1
Average	1.3	1.6	1.5	1.3	1.0	1.2	1.2	1.0	1.0	1.6	1.0	1.4	1.3	1.3	1.0	1.0

SYLLABUS

M.Sc. (Ag.) ENTOMOLOGY

Semester – III

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-301	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Biological Control of Crop Pests and Weeds		
Course Objectives:			
<ol style="list-style-type: none"> 1. To outline history, principles and scope of biological control & biocontrol agents 2. To review biology, adaptation, host seeking behavior & mode of action of parasitoids, predators and insect pathogens 3. To execute biological control of weeds & Mass production techniques of important biocontrol agents 4. To educate about successful biological control projects & other modern techniques in biocontrol 			
UNIT I			
History, principles and scope of biological control; important groups of parasitoids, predators and pathogens; principles of classical biological control- importation, augmentation and conservation,			
UNIT II			
Biology, adaptation, host seeking behaviour of predatory and parasitic groups of insects. Role of insect pathogenic nematodes, viruses, bacteria, fungi, protozoa etc., their mode of action.			
UNIT- III			
Biological control of weeds using insects, Mass production of quality biocontrol agents- techniques, formulations, economics, field release/application and evaluation,			
UNIT-IV			
Successful biological control projects, analysis, trends and future possibilities of biological control. Importation of natural enemies- Quarantine regulations, biotechnology in biological control. Semiochemicals in biological control.			
Practical :			
<ol style="list-style-type: none"> 1. Identification of common natural enemies of crop pests 2. Identification of common weed killer insects 3. Visits to bio-control laboratories to learn rearing and mass production of important bio-control agents 4. Field collection of parasitoids and predators. 5. Hands-on training in culturing, identification of common insect pathogens. 6. Quality control and registration standards for biocontrol agents. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Recall History, definitions, principles and methods of biological control & biocontrol agents			

CO-2: Relate with Biology, adaptation, host seeking behavior & mode of action of parasitoids, predators and insect pathogens
 CO-3: Plan biological control of weeds & Mass production techniques of important biocontrol agents
 CO-4: Assume successful biological control projects & other modern techniques in biocontrol
 CO-5: Evaluate efficacy of different techniques used in biological control
 CO-6: Compose new methods to improve effectiveness of biological control

Suggested readings:

- De Bach P. 1964. Biological Control of Insect Pests and Weeds. Chapman & Hall, New York.
- Dhaliwal GS & Arora R. 2001. Integrated Pest Management: Concepts and Approaches. Kalyani Publ., New Delhi.
- Ignacimuthu SS & Jayaraj S. 2003. Biological Control of Insect Pests. Phoenix Publ., New Delhi.
- Huffaker CB & Messenger PS. 1976. Theory and Practices of Biological Control. Academic Press, London
- S. Sithanatham. 2020. Biological Control Of Insect Pests Using Egg Parasitoids. Springer Nature.

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-		-	-	-	-	-	-	2	2	-	-
CO-2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO-3	1	1	2	-	-	1	-	-	-	-	-	2	2	-	-	2
CO-4	1	1	1	1	-	1	-	-	-	-	2	1	-	-	-	-
CO-5	-	-	-	-	2	-	2	3	2	2	-	2	-	-	2	-
CO-6	-	-	-	-	-	-	-	2	1	-	2	1	-	-	2	-
Average	1.3	1.25	1.5	1	2	1.3	2	2.5	1.5	2	2	1.5	2	1.5	2	2

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-302	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Storage Entomology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To present basic concepts of storage entomology , Post-harvest losses & Important pests associated with grain storage 2. To illustrate detailed description of Important pests associated with storage conditions along with type of losses 3. To learn about ecology of insect pests of stored commodities & information about storage structures 4. To mindmap with management of different types of storage pests 			
UNIT I			
Introduction, history of storage entomology, concepts of storage entomology and significance of insect pests. Post-harvest losses in toto visà-vis total production of food grains in India. Scientific and socio-economic factors responsible for grain losses.			
UNIT II			
Important pests namely insects, mites, rodents, birds and microorganisms associated with stored grain and field conditions including agricultural products; traditional storage structures; association of stored grain insects with fungi and mites, their systematic position, identification, distribution, host range, biology, nature and extent of damage, role of field and cross infestations and natural enemies, type of losses in stored grains and their effect on quality including biochemical changes.			
UNIT- III			
Ecology of insect pests of stored commodities/grains with special emphasis on role of moisture, temperature and humidity in safe storage of food grains and commodities. Stored grain deterioration process, physical and biochemical changes and consequences. Grain storage- types of storage structures i.e., traditional, improved and modern storage structures in current usage. Ideal seeds and commodities' storage conditions.			
UNIT-IV			
Important rodent pests associated with stored grains and their non-chemical and chemical control including fumigation of rat burrows. Role of bird pests and their management. Control of infestation by insect pests, mites and microorganisms. Preventive measures- Hygiene/sanitation, disinfestations of stores/receptacles, legal methods. Curative measuresNon-chemical control measures- ecological, mechanical, physical, cultural biological and engineering. Chemical control- prophylactic and curativeCharacteristics of pesticides, their use and precautions in their handling with special emphasis on fumigants. Integrated approaches to stored grain pest management.			
Practical			
<ol style="list-style-type: none"> 1. Collection and identification of stored grains insect pests and their nature of damage 2. Detection of insect infestation in stored food grains and estimation of stored losses 3. Determination of micro flora of grains 4. Determination of grain moisture 5. Familiarization of storage structures. 6. Laboratory culturing of stored grain pests 7. . Demonstration of preventive and curative measures including fumigation techniques. 8. Field visits to grain markets, central and FCI warehouses, and commercial silos. 			

Course Outcomes (COs): Upon successful completion of the course a student will be able to:

CO-1: Write basic concepts & definitions of storage entomology , Post-harvest losses & about Important pests associated with grain storage

CO-2: Rephrase detailed description of Important pests associated with storage conditions along with type of losses

CO-3: Experiment with Ecology of insect pests of stored commodities & storage structures

CO-4: Test management of different types of storage pests

CO-5: Justify with different principles & methods of storage pest management

CO-6: Design new grain storage structure & methods for safe storage of grains

Suggested readings:

- Khare BP. 1994. Stored Grain Pests and Their Management. Kalyani Publ., New Delhi.
- Subramanyam B & Hagstrum DW. 1995. Interrelated Management of Insects in Stored Products. Marcel Dekker, New York.
- Khader V. 2004. Textbook on Food Storage and Preservation. Kalyani Publ., New Delhi.
- Jayas DV, White NDG & Muir WE. 1995. Stored Grain Ecosystem. Marcel Dekker, New York

CO-PO/PSO Mapping

COs/ POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-	-	-	-	-	-	2	-	-	-	-	-
CO-2	-	2	1	-	-	2	-	-	-	-	1	-	1	-	1	1
CO-3	1	1	2	-	1	1	1	1	1	-	2	-	1	1	1	1
CO-4	1	1	1	1	1	1	-	-	1	1	1	1	2	-	1	1
CO-5	1	1	1	1	1	1	1	1	-	2	-	1	-	2	-	-
CO-6	1	2	1	1	1	1	1	1	2	-	1	-	1	1	1	1
Average	1.2	1.3	1.3	1.0	1.0	1.2	1.0	1.0	1.3	1.5	1.4	1.0	1.25	1.33	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-303	Credit	3(2+1)
Year/Sem	2/III	L-T-P	2-0-1
Course Name	Pests of Horticultural and Plantation Crops		
Course Objectives:			
<ol style="list-style-type: none"> 1. To develop understanding of systematic position , identification, distribution, host-range, biology, damage and management of insect pests of Fruit Crops 2. To relate with systematic position , identification, distribution, host-range, biology, damage and management of insect pests Vegetable crops 3. To acquaint with systematic position , identification, distribution, host-range, biology, damage and management of Plantation crops & spices 4. To study about systematic position , identification, distribution, host-range, biology, damage and management of of insect pests of Ornamental, medicinal and aromatic plants 			
UNIT I			
Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of Fruit Crops- mango, guava, banana, jack, papaya, pomegranate, litchi, grapes, <i>ber</i> , fig, citrus, <i>aonla</i> , pineapple, apple, peach and other temperate fruits			
UNIT II			
Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of Vegetable crops- tomato, potato, radish, carrot, beetroot, cole crops, french beans, chow-chow, brinjal, okra, all gourds, gherkin, drumstick, leafy vegetables etc.,			
UNIT- III			
Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of Plantation crop- coffee, tea, rubber, coconut, arecanut, cashew, cocoa etc.; Spices and Condiments- pepper, cardamom, clove, nutmeg, chillies, turmeric, ginger, beetlevine etc.,			
UNIT-IV			
Systematic position, identification, distribution, host range, bionomics and seasonal abundance, nature and extent of damage and management of insect pests of Ornamental, medicinal and aromatic plants and pests in polyhouses/ protected cultivation.			
Practical :			
<ol style="list-style-type: none"> 1. Collection and identification of important pests and their natural enemies on different horticultural crops 2. Collection and identification of important pests and their natural enemies on different plantation crops 3. Study of life history of important insect pests of fruit crops 4. Study of life history of important insect pests of vegetable crops 5. Study of life history of important insect pests of ornamental crops 6. Study of life history of important insect pests of medicinal & aromatic crops 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Describe information on systematic position , identification, distribution, host-range, biology, damage and management of insect pests of Fruit Crops			
CO-2: Infer with systematic position , identification, distribution, host-range, biology, damage and management of insect pests Vegetable crops			

CO-3: Use systematic position , identification, distribution, host-range, biology, damage to Manage pests of Plantation crops & spices

CO-4: Examine systematic position , identification, distribution, host-range, biology, damage and management of insect pests of Ornamental, medicinal and aromatic plants

CO-5: Interpret bioecological information of insect pests of horticultural crops for their management

CO-6: Improve existing methods & techniques of pest management for environmental safety

Suggested readings:

- Atwal AS & Dhaliwal GS. 2002. Agricultural Pests of South Asia and their Management. Kalyani Publ., New Delhi
- Butani DK & Jotwani MG. 1984. Insects and Vegetables. Periodical Expert Book Agency, New Delhi.
- Dhaliwal GS, Singh R & Chhillar BS. 2006. Essential of Agricultural Entomology. Kalyani Publ., New Delh
- Srivastava RP.1997. Mango Insect Pest Management. International Book Distr., Dehra Dun.

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-	-	-	-	-	-			-	-	-	-
CO-2	-	2	1	-	-	2	-	-	-	-		2	-	-	-	-
CO-3	1	1	2	-	-	1	-	-	2	-	2	1	-	-	-	-
CO-4	1	1	1	1	-	1	-	-	1	-	1	1	-	2	-	1
CO-5	-	-	-	-	1	-	2	2	1	3	1	-	3	1	2	-
CO-6	-	-	-	3	2	-	2	-	-	2	-	-	2	-	-	1
Average	1.3	1.25	1.5	2.0	1.5	1.3	2.0	2.0	1.3	2.5	1.3	1.3	2.5	1.5	2.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-304	Credit	2(1+1)
Year/Sem	2/III	L-T-P	1-0-1
Course Name	Plant Resistance to Insects		
Course Objectives:			
<ol style="list-style-type: none"> 1. To interpret history , basic concepts of resistance and basis of host plant selection in phytophagous insect 2. To impart knowledge of chemical ecology related to host plant resistance 3. To present with breeding for insect resistance in crop plant 4. To relate with Role of biotechnology in plant resistance to insects 			
UNIT I			
History and importance of resistance, principles, classification, components, types and mechanisms of resistance. Insect-host plant relationships; theories and basis of host plant selection in phytophagous insects.			
UNIT II			
Chemical ecology, tritrophic relations, volatiles and secondary plant substances; basis of resistance. Induced resistance - acquired and induced systemic resistance. Factors affecting plant resistance including biotypes and measures to combat them.			
UNIT- III			
Screening techniques; breeding for insect resistance in crop plants; exploitation of wild plant species; gene transfer, successful examples of resistant crop varieties in India and world.			
UNIT-IV			
Role of biotechnology in plant resistance to insects.			
Practical			
<ol style="list-style-type: none"> 1. Screening techniques for measuring resistance 2. Measurement of plant characters and working out their correlations with plant resistance 3. Testing of insect resistance in important crop varieties 4. Bioassay of plant extracts of susceptible/resistant varieties; 5. Demonstration of antibiosis, tolerance and antixenosis 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Present History ,definitions basic concepts of resistance & basis of host plant selection in phytophagous insects.			
CO-2: Explain Chemical ecology related to host plant resistance			
CO-3: Select germplasms regarding breeding for insect resistance in crop plants			
CO-4: Assume the role of biotechnology in plant resistance to insects			
CO-5: Evaluate plant characters and working out their correlations with plant resistance			
CO-6: Improve techniques in HPR			
Suggested readings:			
<ul style="list-style-type: none"> • Painter RH.1951. Insect Resistance in Crop Plants. MacMillan, London • Dhaliwal GS & Singh R. (Eds). 2004. Host Plant Resistance to Insects - Concepts and Applications. Panima Publ., New Delhi. • Maxwell FG & Jennings PR. (Eds). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons, New York. • Panda N & Khush GS. 1995. Plant Resistance to Insects. CABI, London. 			

CO-PO/PSO Mapping :

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	1	1	1	1	1	2	1	-	1	1	-	1	-	1
CO-2	1	1	1	2	1	2	-	1	1	1	2	-	-	2	-	1
CO-3	2	2	2	1	1	1	1	2	2	3	1	-	2	1	-	1
CO-4	1	1	1	3	1	1	1	1	1	-	1	1	-	1	-	-
CO-5	1	1	-	2	1	2	1	1	1	1	2	1	2	2	1	1
CO-6	1	2	1	-	2	1	1	1	2	3	1	-	1	1	1	1
Average	1.3	1.3	1.2	1.8	1.16	1.3	1.5	1.3	1.3	2.0	1.3	1.0	1.6	1.3	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-305	Credit	2(2+0)
Year/Sem	2/III	L-T-P	2-0-0
Course Name	Plant quarantine		
Course Objectives:			
<ol style="list-style-type: none"> 1. To network with Definition, restrictions & case histories related to quarantine 2. To exemplify plant protection organization in India. Acts related to registration of pesticides and Transgenics 3. To appraise techniques to detect pest/pathogen infestations 4. To update knowledge with WTO regulations regarding plant quarantine 			
UNIT I			
Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; quarantine – domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status.			
UNIT II			
Plant protection organization in India. Acts related to registration of pesticides and transgenics. History of quarantine legislations, PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and Export of bio-control agents.			
UNIT- III			
Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material			
UNIT-IV			
WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.			
Practical : NA			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Relate with Definition, restrictions & case histories related to quarantine			
CO-2: Discuss Acts related to registration of pesticides and transgenics			
CO-3: Use techniques to detect pest/pathogen infestations			
CO-4: Examine pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures.			
CO-5: Judge techniques & methods used in plant quarantine			
CO-6: Improve plant quarantine rules & principles			
Suggested readings:			
<ul style="list-style-type: none"> • Rajeev K & Mukherjee RC. 1996. Role of Plant Quarantine in IPM. Aditya Books. • Rhower GG. 1991. Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press. • Muthaiyan M. C.2009. Principles and Practices of Plant Quarantine . Allied Publishers Pvt Ltd 			

CO-PO/PSO Mapping:

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	1	3	-	1	1	-	-	1	1	-	-	1	1	-
CO-2	1	1	1	2	1	-	1	1	-	1	1	-	-	1	1	-
CO-3	2	1	1	3	1	1	1	2	1	1	1	2	-	1	1	2
CO-4	1	1	-	1	-	-	1	1	1	-	1	1	-	1	-	1
CO-5	2	1	1	3	1	1	1	2	2	1	1	1	1	1	1	2
CO-6	1	2	-	1	1	2	1	1	1	-	1	1	1	1	-	1
Average	1.5	1.16	1.0	2.2	1.0	1.25	1.0	1.4	1.25	1.0	1.0	1.25	1.0	1.0	1.0	1.5

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-306	Credit	2(1+1)
Year/Sem	2/III	L-T-P	1-0-1
Course Name	Insect vectors of Plant viruses and other Pathogens		
Course Objectives:			
<ol style="list-style-type: none"> 1. To mindmap with history & basic characteristics of insect vectors 2. To estimate magnitude of transmission of plant viruses and fungal pathogens by sucking insect pests 3. To annotate transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers. 4. To categorize transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers & management of insect transmitted diseases 			
UNIT I			
History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission.			
UNIT II			
Transmission of plant viruses and fungal pathogens. Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips, Relation between viruses and their vectors.			
UNIT- III			
Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.			
UNIT-IV			
Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.			
Practical			
<ol style="list-style-type: none"> 1. Identification of common vectors of plant pathogens 2. Culturing and handling of vectors; 3. demonstration of virus transmission through vectors 4. Efficiency of transmission in different vectors 5. Management of insect transmitted diseases through vector management. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO1: Recall history & basic characteristics of insect vectors			
CO2: Explain transmission of plant viruses and fungal pathogens by sucking insect pests			
CO3: Experiment with transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.			
CO4: Analyze transmission of plant viruses by psyllids, beetles and mites.			
CO-5: Select correct management methods of vector management.			
CO-6: Invent new methods of vector borne plant disease management			
Suggested readings:			
<ul style="list-style-type: none"> • Basu AN. 1995. Bemisia tabaci (Gennadius) - Crop Pest and Principal Whitefly Vector of Plant Viruses. Oxford & IBH, New Delhi. • Harris KF & Maramarosh K. (Eds.).1980. Vectors of Plant Pathogens. Academic Press, London. • Maramorosch K & Harris KF. (Eds.). 1979. Leafhopper Vectors and Plant Disease Agents. Academic Press, London. • Youdeovei A & Service MW. 1983. Pest and Vector Management in the Tropics. English Language Books Series, Longman, London. 			

CO-PO/PSO Mapping:

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	1	1	-	2	1	1	1	-	2	1	2	1	1	1
CO-2	1	2	1	-	1	1	1	1	-	1	1	1	1	2	1	1
CO-3	1	-	-	1	1	-	-	1	1	1	-	-	1	-	-	1
CO-4	1	1	1	1	-	1	2	2	1	1	1	2	1	1	2	-
CO-5	1	-	-	1	1	1	1	1	1	-	1	1	1	1	-	1
CO-6	1	2	1	1	1	2	2	1	1	1	2	2	1	1	2	-
Average	1.16	1.5	1.0	1.0	1.0	1.4	1.4	1.16	1.0	1.0	1.4	1.4	1.16	1.2	1.5	1.0

SYLLABUS
M.Sc. (Ag.) ENTOMOLOGY
Semester – IV

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEC-401	Credit	3(2+1)
Year/Sem	2/IV	L-T-P	2-0-1
Course Name	Techniques in Plant Protection		
Course Objectives:			
<ol style="list-style-type: none"> 1. To implement maintenance & working of Pest control equipments 2. To explain soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests 3. To collaborate with use of microscopy & molecular approaches in entomology 4. To facilitate use of tissue culture techniques & Computer application in plant protection. 			
UNIT I			
Pest control equipments, principles, operation, maintenance, selection, application of pesticides and biocontrol agents, seed dressing, soaking, root-dip treatment, dusting, spraying, application through irrigation water.			
UNIT II			
Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests through seed, bulbs, corms, cuttings and cut flowers.			
UNIT- III			
Use of light, transmission and scanning electron microscopy. Protein isolation from the pest and host plant and its quantification using spectrophotometer and molecular weight determination using SDS/PAGE.			
UNIT-IV			
Use of tissue culture techniques in plant protection. Computer application for predicting/forecasting pest attack and identification.			
Practical			
<ol style="list-style-type: none"> 1. Handling & maintenance of plant protection equipments 2. Different methods of pesticide application 3. Soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests 4. Use of microscopy techniques in plant protection 5. Protein isolation from the pest and host plant and its quantification & molecular weight determination 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Describe maintenance & working of Pest control equipments			
CO-2: Demonstrate soil sterilization, solarization, deep ploughing, flooding, techniques to check the spread of pests			
CO-3: Use of microscopy & molecular approaches in entomology			
CO-4: Simplify use of tissue culture techniques & Computer application in plant protection.			
CO-5: Choose appropriate techniques in plant protection			
CO-6: Design new, innovative & technical approaches in entomology			
Suggested readings:			
<ul style="list-style-type: none"> • Alford DV. 1999. A Textbook of Agricultural Entomology. Blackwell Science, London. • Crampton JM & Eggleston P. 1992. Insect Molecular Science. Academic Press, London. 			

CO-PO/PSO Mapping:

COs/ POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2	-	-	-	-	-	-	-	2	-	-	2	-	-
CO-2	1	2	1	-	-	2	-	-	-	-	-	2	-	1	-	-
CO-3	1	1	2	-	-	1	2	-	-	-	2	-	2	3	-	1
CO-4	1	1	1	1	-	1	-	2	2	-	-	2	-	-	1	-
CO-5	-	-	-	2	2	-	2	2		2	-	-	-	-	1	1
CO-6	-	-	-	-	1	-	-	-	3		-	-	2	-	1	1
Average	1.25	1.5	1.5	1.5	1.5	1.3	2.0	2.0	2.5	2.0	2.0	2.0	2.0	2.0	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-402	Credit	3(2+1)
Year/Sem	2/IV	L-T-P	2-0-1
Course Name	Commercial Entomology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To get management skills on bee colony & production of quality honey 2. To understand technical know-how on management of silk worms & lac insect in commercial aspect 3. To sketch about economic and public health importance of insect pests in human habitation and habitats 4. To implement principles and methods of pest management in residential places and public buildings 			
UNIT I			
Bee keeping- General colony management during different seasons. Seasonal management. Managing colonies for honey production and pollination. Artificial queen rearing. Pests and diseases of honey bees. Bee poisoning. Production and marketing of quality honey and value added honey products. Establishment and maintenance of apiaries.			
UNIT II			
Study of different species of silkworms, characteristic features, moriculture, silk and its uses, pests and diseases of silkworms, rearing and management of silkworms. Lac insect- natural enemies and their management.			
UNIT- III			
Economic and public health importance of insect pests in human habitation and habitats, biology, damage and control of mosquitoes, houseflies, bed bugs, ants, termites, cockroaches, flies, silverfish, head and body lice, carpet beetles, cloth moths, crickets, wasps, house dust mites, insect pests of cattle, poultry, pet animals and their management.			
UNIT-IV			
Principles and methods of pest management in residential places and public buildings, insecticides for domestic use and their safety, pre- and post construction termite proofing of buildings, appliances for domestic pest control. Rodent control methods. Organic methods of domestic pest management.			
Practical:			
<ol style="list-style-type: none"> 1. Identification of honey bee species, bee castes and special adaptations, identification and handling of bee-keeping equipments. 2. Honey extraction and processing methods of hive products extraction 3. Silkworm rearing and management. 4. Lac host and crop 28 management technology and processing of lac 5. Assessing pest status in dwellings (labs, canteen or hostel) & their management 6. Pre- and post-construction termite proofing methods 7. Rodent control methods 8. Organic methods of domestic pest management. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Write basic terms & concepts used in commercial Entomology			
CO-2: Demonstrate management of honey bees, silk worms & lac insect in commercial aspect			
CO-3: Organize principles and methods of pest management in residential places and public buildings			
CO-4: Analyze economic and public health importance of insect pests in human habitation and habitats			

CO-5: Evaluate different methods for effective management of beneficial insects

CO-6: Improve techniques in commercial Entomology

Suggested readings:

- Atwal AS. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
- Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi
- Partiban S & David BV. 2007. Management of Household Pests and Public Health Pests. Namratha Publ., Chennai
- Singh S. 1975. Beekeeping in India. ICAR, New Delhi.

CO-PO/PSO Mapping:

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO-2	-	2	1	-	1	2	-	-	-	-	-	-	-	1	-	-
CO-3	1	1	2	-	-	1	2	3	-	-	2	1	2	-	-	1
CO-4	1	1	1	1	-	1	-	-	2	1	-	2	-	-	1	1
CO-5	-	-	-	2	2	-	-	-	-	2	-	-	-	-	1	1
CO-6	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-
Average	1.3	1.25	1.5	1.5	1.5	1.3	2.0	2.5	2.0	1.5	1.5	1.5	2.0	1.5	1.0	1.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-403	Credit	3(2+1)
Year/Sem	2/IV	L-T-P	2-0-1
Course Name	General Acarology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To associate with history ,importance ,habitat, collection and preservation of mites. 2. To illustrate morphology ,biology ,classification including diagnostic characteristics of mites 3. To network economic importance, seasonal occurrence, nature of damage, host range of mite pests in different crops. 4. To explain management & Culturing of phytophagous, parasitic and predatory mites. 			
UNIT I			
History of Acarology; importance of mites as a group; habitat, collection and preservation of mites.			
UNIT II			
Introduction to morphology and biology of mites and ticks. Broad classification- major orders and important families of Acari including diagnostic characteristics.			
UNIT- III			
Economic importance, seasonal occurrence, nature of damage, host range of mite pests of different crops, mite pests in polyhouses, mite pests of stored products and honeybees.			
UNIT-IV			
Management of mites using acaricides, phytoseiid predators, fungal pathogens etc. Culturing of phytophagous, parasitic and predatory mites.			
Practical :			
<ol style="list-style-type: none"> 1. Collection of mites from plants, soil and animals 2. Extraction methods of mites from soil, plants and stored products; 3. Preparation of mounting media and slide mounts for mites 4. External morphology of mites 5. Identification of mites up to family level using keys; 6. Studying different rearing techniques for mites. 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Describe History ,importance ,habitat, collection and preservation of mites.			
CO-2: Outline morphology ,biology ,classification including diagnostic characteristics of mites			
CO-3: Utilize seasonal occurrence, biology & nature of damage of mites for their management			
CO-4: Compare management & Culturing techniques of phytophagous, parasitic and predatory mites.			
CO-5: Judge different methods for effective management of mite pests			
CO-6: propose new techniques & methods in acarology			
Suggested readings:			
<ul style="list-style-type: none"> • Chhillar BS, Gulati R & Bhatnagar P. 2007. Agricultural Acarology. Daya Publ. House, New Delhi. • Gupta SK. 1985. Handbook of Plant Mites of India. Zoological Survey of India, Calcutta • Walter DE & Proctor HC. 1999. Mites- Ecology, Evolution and Behaviour. CABI, London. • Krantz GW. 1970. A Manual of Acarology. Oregon State Univ. Book Stores, Corvallis, Oregon. 			

CO-PO/PSO Mapping:

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-		-	-	-	-	1		2	2	-	-
CO-2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO-3	1	1	2	-	-	1	2	1	-	-	2	-	2	-	-	2
CO-4	1	1	1	1	2	1	-	2	-	2	-	1	-	-	-	-
CO-5	-	-	-	1	2	-	1	1	1	-	-	-	-	-	-	-
CO-6	-	-	-	1	-	-	1	-	2	2	-	2	-	-	-	-
Average	1.3	1.25	1.5	1.0	2.0	1.3	2.0	2.0	1.5	2.0	1.5	1.5	2.0	1.5	-	2.0

Programme Name	M.Sc. (Ag.) Entomology	Programme Code	MSC-ENTO-1033
Course Code	MSEE-404	Credit	3(2+1)
Year/Sem	2/IV	L-T-P	2-0-1
Course Name	Insect Pathology		
Course Objectives:			
<ol style="list-style-type: none"> 1. To present history of insect pathology & infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes 2. To explain epizootiology, symptomatology and etiology of diseases caused by insect pathogens. 3. To appraise success stories and mass production techniques of pathogens 4. To collaborate safety and registration of microbial pesticides & use of insect pathogens in integrated management . 			
UNIT I			
History of insect pathology, infection of insects by bacteria, fungi, viruses, protozoa, rickettsiae, spiroplasma and nematodes.			
UNIT II			
Epizootiology, symptomatology and etiology of diseases caused by the above and the factors controlling these. Defense mechanisms in insects against pathogens.			
UNIT- III			
Examples of successful instances of exploitation of pathogens for pest management and mass production techniques of pathogens			
UNIT-IV			
Safety and registration of microbial pesticides. Use of insect pathogens in integrated management of insect pests.			
Practical:			
<ol style="list-style-type: none"> 1. Familiarization with equipment used in insect pathology laboratory. 2. Identification of different groups of insect pathogens and symptoms of infection 3. Isolation, culturing and testing pathogenicity of different groups of pathogens. 4. Testing Koch's postulates 5. Extraction of pathogens from infected & dead insect 			
Course Outcomes (COs): Upon successful completion of the course a student will be able to:			
CO-1: Recall history, terms used & basic concepts in insect pathology			
CO-2: Outline epizootiology, symptomatology and etiology of diseases caused by insect pathogens.			
CO-3: Make use of different mass production techniques of pathogens			
CO-4: Examine the role of insect pathogens in integrated pest management .			
CO-5: Decide the use of correct insect pathogen in pest management			
CO-6: Develop new and improved methods of studying & culturing insect pathogens			
Suggested readings:			
<ul style="list-style-type: none"> • Boucias DG & Pendland JC. 1998. Principles of Insect Pathology. Kluwer Academic Publisher, Norwel. • Steinhaus EA. 1984. Principles of Insect Pathology. Academic Press, London. • Burges HD & Hussey NW. (Eds). 1971. Microbial Control of Insects and Mites. Academic Press, London. 			

CO-PO/PSO Mapping:

COs/ POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-		-	-	-	-		-	2	2	-	-
CO-2	-	2	1	-	-	2	-	-	-	-		-	-	1	-	-
CO-3	1	1	2	-	-	1	-	-	-	-	1	-	2	-	-	2
CO-4	1	1	1	1	-	1	-	2	-	2	1	1	-	-	-	-
CO-5	-	-	-	-	3	-	3	2	-	-	2	2	-	2	3	2
CO-6	-	-	-	2	2	-	1	-	2	3	2	3	-	-	2	-
Average	1.3	1.25	1.5	1.5	2.5	1.3	2.0	2.0	2.0	2.5	1.5	2.0	2.0	1.5	2.5	2.0

Programme Name	M.Sc. Ag. (Entomology)	Programme Code	MSC-ENTO-1033
Course Code	MSES-405	Credit	1(0+1)
Year/Sem	2/IV	L-T-P	0-0-1
Course Name	Master's Seminar		
Course Objectives:			
<ol style="list-style-type: none"> 1. To acquaint with scientific terms, concepts and content preparation, etc. 2. To develop the ability to make power point and presentation. 3. To develop the ideas for using photographs and sketches in power point to give valuable information. 4. To develop the skills of preparation of research proposal or synopsis, report, manuscripts/article and publications and use of computer programs etc. 			
Practical :			
<p>A power point presentation on any topic chosen from the courses studied to be prepared and delivered to the group of faculty members/staff and students of department.</p> <p>Essential components of Presentation are:</p> <p>Organization of topic, Presentation of data. Oral presentation, Delivery, language, explanation of figures, Ability to grasp and understand the subject, Depth of understanding the topic.</p>			
Upon successful completion of the course a student will be able to:			
CO1: Relate with scientific terms, concepts and content preparation, etc.			
CO2: Outline and summarize presentation.			
CO3: Organize photographs and sketches in power point to give valuable information.			
CO4: Examine research proposal or synopsis, report, manuscripts/article and publications.			
CO-5: Evaluate language, figures & delivery methods			
CO-6: Compose effective scientific presentation			
Suggested readings:			
Grover, S. and Ameen, S. 2018. A Primer of Research, Publication and Presentation. Jaypee Publisher, New Delhi.			

CO-PO/PSO Mapping

COs POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-	-	-	-	-	-			-	-	-	-
CO-2	-	2	1	-	-	2	-	-	-	-		2	-	-	-	-
CO-3	1	1	2	-	-	1	-	-	2	-	2	1	-	-	-	-
CO-4	1	1	1	1	-	1	-	-	1	-	1	1	-	2	-	1
CO-5	-	-	-	-	1	-	2	2	1	3	1	-	3	1	2	-
CO-6	-	-	-	3	2	-	2	-	-	2	-	-	2	-	-	1
Average	1.3	1.25	1.5	2.0	1.5	1.3	2.0	2.0	1.3	2.5	1.3	1.3	2.5	1.5	2.0	1.0

Programme Name	M.Sc. Ag. (Entomology)	Programme Code	MSC-ENTO-1033
Course Code	MSET-406	Credit	20(0+20)
Year/Sem	2/IV	L-T-P	0-0-20
Course Name	Master's Thesis Research		
<p>Course Objectives: The objectives of this course are:</p> <ol style="list-style-type: none"> 1. Aim of introducing thesis in M.Sc. (Ag.) Entomology is to give the students preliminary exposure for conducting the research and presenting its findings systematically and scientifically in a manuscript shape. 2. To fulfill this goal, a specific topic for thesis research shall be assigned to M.Sc. student by the teacher(s)/supervisor(s) of the department, in the first semester 3. The student will carry out the research for thesis under the respective supervisor(s) and finally present it in a book shape called thesis 			
<p>Practical</p> <p>Synopsis, Research Work & Thesis work provides the students an excellent opportunity to develop analytical research and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and investigate the things.</p>			
<p>Upon successful completion of the course a student will be able to:</p> <p>CO.1: Remember scientific terms of research designing, citation and bibliography.</p> <p>CO.2: Summarize ethical dimensions of research work and knowledge</p> <p>CO.3: Choose appropriate methods for scientific measurements, statistical calculations and analysis of data.</p> <p>CO.4: Assume research works, collection, classification, presentation and analysis of data.</p> <p>CO-5: Evaluate language, figures & delivery methods for research</p> <p>CO-6: Compose research project</p>			
<p>Suggested readings:</p> <ul style="list-style-type: none"> • Kumar, R. 2014. Research Methodology: A Step-by-Step Guide for Beginners. 4th Edition. SAGE Publications Ltd. • Parikh, M.N, Gogtay, N. 2009. ABC of Research Methodology and Applied Biostatistics. Jaypee Publishers, New Delhi. 			

CO-PO/PSO Mapping

COs/ POs/	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO -1	PSO-2	PSO-3	PSO-4
CO-1	2	1	2	-	-		-	-	-	-	-	-	2	2	-	-
CO-2	-	2	1	-	-	2	-	-	-	-	-	-	-	1	-	-
CO-3	1	1	2	-	-	1	-	-	-	-	-	2	2	-	-	2
CO-4	1	1	1	1	-	1	-	-	-	-	2	1	-	-	-	-
CO-5	-	-	-	-	2	-	2	3	2	2	-	2	-	-	2	-
CO-6	-	-	-	-	-	-	-	2	1	-	2	1	-	-	2	-
Average	1.3	1.25	1.5	1	2	1.3	2	2.5	1.5	2	2	1.5	2	1.5	2	2